What is claimed is:

1 1.   A coder comprising:

2   an obtaining unit that obtains a predetermined

3 amount of image data in which each pixel is expressed by a

4 plurality of bits;

5   a developing unit that develops the pieces of bit

6 data in the image data on virtual planes, wherein pieces

7 of bit data of the same pixel are developed on the same

8 virtual plane; and

9   a coding unit that performs entropy coding on the

10 developed bit data in virtual plane units.

1 2.   The coder according to Claim 1, wherein the pixel

2 is expressed by 8 bits.

1 3.   The coder according to Claim 2, wherein the

2 developing unit develops pieces of bit data of each pixel

3 in a 2 bit by 4 bit matrix.

1 4.   The coder according to Claim 1, wherein the

2 predetermined amount of image data is image data

3 corresponding to one page.

1 5.   The coder according to Claim 1, wherein the coding

2 unit obtains a probability value of a target bit from

3 reference bits and performs an arithmetic coding with

4 prediction according to the obtained probability value,

5 wherein the target bit is a subject of coding and the

6 reference bits are in predetermined positions relative to

7 the target bit.

1 6.   The coder according to Claim 1, wherein the

2 developing unit performs code conversion on the

3 predetermined amount of image data before developing the

4 pieces of bit data.

1 7.   The coder according to Claim 6, wherein binary

2 data is converted to gray codes in the code conversion.

1 8.   A coder comprising:

2   an obtaining unit that obtains a predetermined

3 amount of image data in which each pixel is expressed by a

4 plurality of bits;

5   a BTC (Block Truncation Coding) processing unit .

6 that performs BTC processing on the obtained image data to

7 obtain gradation characteristic data and quantized data;

8   a developing unit that develops pieces of bit data

9 in the obtained gradation characteristic data on virtual

10 planes; and

11   a coding unit that performs entropy coding on the

12 developed bit data in virtual plane units.

44

9.   The coder according to Claim 8, wherein the developing unit performs code conversion on the obtained gradation characteristic data before developing the pieces of bit data.

10.   A coding method comprising:

an obtaining step for obtaining a predetermined amount of image data in which each pixel is expressed by a plurality of bits;

a developing step for developing the pieces of bit data in the image data on virtual planes, wherein pieces of bit data of the same pixel are developed on the same virtual plane; and

a coding step for performing entropy coding on the developed bit data in virtual plane units.

11.   A coder comprising:

an obtaining unit that obtains a predetermined number of pixels of multivalued image data;

a BTC processing unit that generates gradation characteristic data and quantized data from pixel values of the pixels of the obtained multivalued image data;

a developing unit that develops pieces of bit data in the gradation characteristic data on first virtual planes; and

10   a coding unit that performs entropy coding on the

11   developed bit data in first virtual plane units.

1   12.   The coder according to Claim 11, wherein

2   the developing unit develops pieces of bit data in

3   the quantized data on at least one second virtual plane,

4   and

5   the coding unit performs the entropy coding on the

6   developed bit data in the quantized data in second virtual

7   plane units.

1   13.   The coder according to Claim 12, wherein each

2   piece of the quantized data corresponding to a different

3   one of the pixels includes a plurality of pieces of bit

4   data,

5   the coder further comprising a dividing unit that

6   divides the pieces of bit data in the quantized data into

7   a plurality of groups, wherein the developing unit

8   develops pieces of bit data in the quantized data in a

9   different group on a different virtual plane.

1   14.   The coder according to Claim 13, wherein the

2   plurality of groups are a first group of upper bit data

3   and a second group of lower bit data.

1   15.   The coder according to Claim 13, wherein

2   the predetermined number of pixels indicates a

3 block of 4 pixels * 4 pixels, and

4   the developing unit develops pieces of bit data in

5 each of the groups obtained from each block of the

6 multivalued image data in a 4 bit by 4 bit matrix.

1 16.   The coder according to Claim 12, wherein each

2 piece of the quantized data corresponding to a different

3 one of the pixels includes a plurality of pieces of bit

4 data,

5   the coder further comprising:

6   a compression ratio obtaining unit that obtains a

7 compression ratio for the entropy coding; and

8   a judging unit that judges whether another

9 quantized data is necessary according to the compression

10 ratio.

1 17.   The coder according to Claim 11, wherein the

2 developing unit performs code conversion on the pieces of

3 bit data in the gradation characteristic data before

4 developing the pieces of bit data in the gradation

5 characteristic data.

1 18.   The coder according to Claim 17, wherein binary

2 data is converted to gray codes in the code conversion.

1 19. The coder according to Claim 11, wherein each

2 pixel is expressed by 8 bits in the multivalued image

3 data.

1 20. The coder according to Claim 11, wherein the

2 predetermined number of pixels indicates a block of 4

3 pixels * 4 pixels.

1 21. The coder according to Claim 20, wherein the

2 developing unit develops the pieces of bit data in the

3 gradation characteristic data obtained from each block of

4 the multivalued image data in a 4 bit by 4 bit matrix.

1 22. The coder according to Claim 11, further

2 comprising a converting unit that converts the quantized

3 data into a predetermined bit string, wherein the coding

4 unit performs the entropy coding on the bit string.

5 23. A coding method comprising:

6 an obtaining step for obtaining a predetermined

7 number of pixels of multivalued image data;

8 a BTC processing step for performing BTC

9 processing on pixel values of the pixels of the obtained

10 multivalued image data and generating gradation

11 characteristic data and quantized data;

12 a developing step for developing pieces of bit

13 data in the gradation characteristic data on virtual

14 planes; and

15   a coding step for performing entropy coding on the

16 developed bit data in virtual plane units.

1 24. An image forming apparatus comprising:

2   a coder that includes:

3   an obtaining unit that obtains a predetermined

4 amount of image data in which each pixel is expressed by a

5 plurality of bits;

6   a developing unit that develops the pieces of bit

7 data in the image data on virtual planes, wherein pieces

8 of bit data of the same pixel are developed on the same

9 virtual plane;

10   a coding unit that performs entropy coding on the

11 developed bit data in virtual plane units;

12   a decoder that decodes data that has been coded by

13 the coder and reconstructs image data; and

14   an image forming unit that forms an image using

15 the image data that has been reconstructed by the decoder.

1 25. An image forming apparatus comprising:

2   a coder that includes:

3   an obtaining unit that obtains a predetermined

4 number of pixels of multivalued image data;

5   a BTC processing unit that generates gradation

6   characteristic data and quantized data from pixel values

7   of the pixels of the obtained multivalued image data;

8   a developing unit that develops pieces of bit data

9   in the gradation characteristic data on first virtual

10 planes;

11   a coding unit that performs entropy coding on the

12 developed bit data in first virtual plane units;

13   a decoder that decodes data that has been coded by

14 the coder and reconstructs image data; and

15   an image forming unit that forms an image using

16 the image data that has been reconstructed by the decoder.

1   26.   A computer program that performs coding processing

2   of image data has a computer execute steps, the steps

3   comprising:

4   a developing step for developing on virtual planes

5   pieces of bit data in image data in which each pixel is

6   expressed by a plurality of bits, wherein pieces of bit

7   data of the same pixel are developed on the same virtual

8   plane; and

9   a coding step for performing entropy coding on the

10 developed bit data in virtual plane units.

1   27.   A computer program that performs coding processing

2   of image data has a computer execute steps, the steps

3   comprising:

50

4   an obtaining step for obtaining a predetermined

5   number of pixels of multivalued image data;

6   a BTC processing step for generating gradation

7   characteristic data and quantized data from pixel values

8   of a plurality of pixels of multivalued image data;

9   a developing step for developing pieces of bit

10   data in the gradation characteristic data on virtual

11   planes; and

12   a coding step for performing entropy coding on the

13   bit data in virtual plane units.